

# Integrating SDN for IoT Management

## Context:

The continuing growth in the interest and development of Internet of Things (IoT) industry will lead us into a world where various “things” with different capabilities and purposes will all be intertwined together through wireless technology. Different open-platform solutions already allow us to also become a part of this, such as RIOT [1] and IoTivity [2]. The heterogeneity of these devices, however, calls for a need of common leveraging of network operating system (NOS) that can program, control, and manage networking layers independent to the operating system [3].

So enter software defined networking (SDN). SDN platforms allow management of networks through differentiation in the control plane and data plane, where different APIs are provided to users in the control plane to design enhanced networking solutions that are befitting to targeted application. Fortunately, we are able to easily access and experiment with these SDN platforms, as they are also open to use for developers. Our goal is to exploit this chance to look into and apply these solutions, most notably the open network operating systems (ONOS) [4].

When SDN solutions can be applied to control and management of IoT networks, the developer can utilize the APIs to easily define and program innovative solutions that can enhance the performance of the network. This may include application-specific route management, traffic load balancing, energy consumption balancing, etc. Furthermore, advanced management of SDN can allow us to efficiently control and collect numerous data emanating from IoT devices, potentially enabling us to manage big data.

In this project, we would like to use the tools open to us to configure a SDN-based IoT environment, and design our own methods of controlling the network through the provided APIs.

## Objective:

- To configure a SDN-based IoT environment using simulation, emulation, and/or hardware implementation.
- To design a novel network control application based on the characteristic of the configured IoT environment.

## Potential tools:

We have identified certain tools that could be used to complete the project, but this is not an exhaustive list and the candidate is free to explore other options:

- Existing network simulators (ns3/cooja)
- Emulated IoT testbeds (Onelab: <https://www.onelab.eu/>)
- Embedded IoT devices (Sensor motes, Arduino, Raspberry pi)

# Methodology

This project should be conducted with an engineering-savvy and scientifically sound approach. As a methodology, the student should follow the classical scientific approach:

1. State of the art: Analyze the current trends in SDN, IoT platform development to understand its characteristics.
2. Draft proposal: Propose SDN/IoT platforms that will be used throughout the research.
3. Implementation: Program/configure the proposed platforms and applications on target environment.
4. Evaluation: soundness of the design, performance analysis of the proposed application design.

## Requirements:

- Good knowledge of C/C++ and embedded C
- Basic understanding of developing in Linux environments and Linux kernel architecture
- Basic understanding of L2/L3 network layer in wireless communications (MAC, Routing)

## References

- [1] E. Baccelli, et al., "RIOT OS: Towards an OS for the Internet of Things." Computer Communications Workshops (INFOCOM WKSHPS), 2013 IEEE Conference on. IEEE, 2013.
- [2] C. Lee, et al., "Design and implementation of a universal smart energy management gateway based on the Internet of Things platform," Consumer Electronics (ICCE), 2016 IEEE International Conference on, Jan. 2016.
- [3] A. Anadiotis, et al., "Towards a software-defined Network Operating System for the IoT," Internet of Things (WF-IoT), 2015 IEEE 2nd World Forum on, Dec. 2015.
- [4] P. Berde, et al., "ONOS: Towards an Open, Distributed SDN OS," ACM SIGCOMM Workshop on Hot Topics in Software Defined Networking (HotSDN 2014), Aug. 2014.

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